DIGI PUNCH2™ TECHNOLOGY
Reliable Data Communications in Harsh RF Environments
Digi Punch2 Technology

Reliable Data Communications in Harsh RF Environments

Today companies in the oil/gas, agriculture and utility industries are increasingly deploying remote sensors and controllers to reduce costs, improve precision control and increase safety. But it’s often physically impossible or cost-prohibitive to use cables and wires to connect these devices to a central management infrastructure.

To overcome these obstacles, companies often turn to unlicensed 900 MHz wireless solutions to connect devices over longer distances. However, these often-harsh environments can present conditions that decrease reliability and hinder performance of wireless signals. For example, many oil and gas fields are saturated with RF noise, which can lead to an unacceptable amount of interference and data loss.

Responding to these challenges, Digi has developed the Digi XLR PRO™, a long-range 900 MHz industrial radio designed to replace Ethernet or serial-cable connectivity for transmitting remote field data. Leveraging Digi’s patent-pending Punch2™ Technology, the Digi XLR PRO offers exceptional interference suppression in noisy RF environments with a reliable line-of-site range from 1 to more than 100 miles.
A Closer Look At Punch2 Technology

Punch2 Technology leverages chirp spread spectrum (CSS) modulation to provide better receive sensitivity, multipath performance and interference rejection than is available through traditional frequency hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS) systems. The advantages of Punch2 Technology arise from the characteristics of the chirp signal (a signal that sweeps from one frequency to another) as well as several digital-signal-processing techniques that enhance performance and reliability.

With Punch2 Technology, data is spread to a higher bandwidth by multiplying each transmit modulation symbol with a chirp signal, which results in greater receive sensitivity, increased interference immunity, improved multipath performance and widely adjustable data rates.
The Advantages of Punch2 Technology

1 Greater Receive Sensitivity

Punch2 Technology leverages chirp spreading to deliver higher processing gains for greater receive sensitivity. It more efficiently processes signals while also filtering out narrowband noise. During the de-spreading process, any signal that does not correlate with the chirp signal is filtered, primarily leaving the desired signal. The signal-to-interference (SIR) ratio of the de-spread signal is sufficiently high for recovery of the data, even though the power of the interference exceeded the power of the desired signal.

2 Interference Immunity

Punch2 Technology uses frequency domain filtering techniques to suppress any narrowband interference from other radios. Punch2 Technology can suppress narrowband interference by up to 65 dB.

3 Improved Multipath Performance

Multipath occurs when a radio signal travels along different paths, often bouncing off obstacles like trees or buildings, causing the signal to interfere with itself. Punch2 Technology uses a rake receiver architecture to coherently recover multipath signals. All packets transmitted using Punch2 Technology benefit from multipath recovery and, therefore, are more likely to be received error-free.

4 Widely Adjustable Data Rates

The Digi XLR PRO radio supports data-rate changes ranging from 9.38 Kbps to 3.18 Mbps. A lower data rate can be used if interference is significant or the signal to be received is weak. This significantly improves the ability of the Digi XLR PRO to maintain communication in harsh RF environments.
Field Testing: Punch2 Technology Outperforms Competitors

To demonstrate the effectiveness of Punch2 Technology in the field, Digi recently conducted long-range transmission tests and compared the performance of Digi XLR PRO radios against leading competitor radios. These tests were conducted in an oil field near Myton, Utah. Competitor A radios were configured to transmit at 115.2 kbps for all tests. Digi XLR PRO and Competitor B radios’ data rates were adjusted throughout the testing, as noted. All radios were configured to 1 Watt RF output power.

The area chosen for testing was in the vicinity of many drilling pads and near a cell phone tower. A 900 MHz dipole antenna attached to a portable spectrum analyzer captured the RF noise present at the site. A single sweep of the ISM 915 MHz band showed many narrowband interferers operating at levels above -60 dBm. Dipole antennas were mounted on an 8-foot tripod and connected to each radio through a 6-foot RF cable. Data packet lengths were 32 bytes.

Radios were compared for long-range transmission capabilities in an oil field in Myton, Utah, with 1.4 miles (2.25 kilometers) of distance transmission tested.
The test consisted of the following steps:

1. Base station transmitted a packet to the remote radio.
2. If packet was received by remote radio, the loopback connector caused it to transmit the packet back.
3. If the base station received the response, the test recorded one good packet.
4. If the response was not received by a defined timeout (usually 1 second), the test recorded 1 bad packet.
5. The test was repeated until the percentage of good vs. bad packets stabilized, and the result was recorded.

Test Results

1.4 Miles Transmission Distance Test 1:

<table>
<thead>
<tr>
<th>Radio</th>
<th>Pct of Packets Received</th>
<th>Transmission Rate</th>
<th>Packet Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digi XLR PRO</td>
<td>96</td>
<td>141 kbps</td>
<td>32 bytes</td>
</tr>
<tr>
<td>Radio A</td>
<td>13</td>
<td>115 kbps</td>
<td>32 bytes</td>
</tr>
<tr>
<td>Radio B</td>
<td>35</td>
<td>125 kbps</td>
<td>32 bytes</td>
</tr>
</tbody>
</table>

0.8 Miles Transmission Distance Test 2:

<table>
<thead>
<tr>
<th>Radio</th>
<th>Pct of Packets Received</th>
<th>Transmission Rate</th>
<th>Packet Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digi XLR PRO</td>
<td>100</td>
<td>141 kbps</td>
<td>32 bytes</td>
</tr>
<tr>
<td>Radio A</td>
<td>58</td>
<td>115 kbps</td>
<td>32 bytes</td>
</tr>
</tbody>
</table>

0.4 Miles Transmission Distance Test 3:

<table>
<thead>
<tr>
<th>Radio</th>
<th>Pct of Packets Received</th>
<th>Transmission Rate</th>
<th>Packet Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digi XLR PRO</td>
<td>100</td>
<td>3,100 kbps</td>
<td>32 bytes</td>
</tr>
<tr>
<td>Radio A</td>
<td>95</td>
<td>115 kbps</td>
<td>32 bytes</td>
</tr>
<tr>
<td>Radio B</td>
<td>97</td>
<td>1,200 kbps</td>
<td>32 bytes</td>
</tr>
</tbody>
</table>
Field Test Conclusions

These results confirm that companies can achieve significant, meaningful improvements in interference immunity with the Digi XLR PRO, which can communicate across a longer range at higher data rates and with fewer packet errors than alternative radios in the market.

The Digi XLR PRO also demonstrated advantages by establishing a solid link over distances at which other radios were unable to communicate reliably even at a lower data rates (125 kbps vs. 141 kbps). At closer ranges, the Digi XLR PRO achieved nearly double the data rates of other radios.

For wireless data communications in mission-critical applications, the reliability of each link is critical to the long-term success of the network. Punch2 Technology enables the Digi XLR PRO 900 MHz industrial radio to achieve an unparalleled range of 1 to 100-plus miles, industry-leading receive sensitivity, interference immunity and reliability in harsh RF environments.
Key Takeaways

- Patent-pending Punch2™ Technology overcomes RF noise with innovative interference suppression on unlicensed 900 MHz spectrum.
- Punch2 Technology provides greater receive sensitivity, interference immunity, improved multipath performance, and support for dynamic data rates.
- Digi’s internal tests found that XLR PRO™ radios equipped with Punch2 Technology can communicate more reliably than competing alternatives at longer distances, with higher data rates, and with fewer packet errors.

Contact a Digi expert and get started today

PH: 877-912-3444
www.digi.com

Digi International
9350 Excelsior Blvd.
Suite 700
Hopkins, MN 55343

Digi International - Germany
+49-89-540-428-0

Digi International - Japan
+81-3-5428-0261

Digi International - Singapore
+65-6213-5380

Digi International - China
+86-21-5049-2199

© Copyright 2015 Digi International Inc. All rights reserved. 91003021  B3/1118